4

WHAT IS HAPPENING IN THE FIELD

Introduction

This chapter discusses what we discovered in our research regarding the development and implementation of digital environments. Over one hundred interviews were conducted at more than thirty sites. Site observations highlighted a few obstacles that slow an organization's evolution of an Acquisition Program's Digital Environment (APDE) and a few key characteristics that help others gain momentum along the APDE continuum.

There is no universal APDE standard or *truth* among the organizations examined. There are just too many implementation options available. As one expert in industry so fittingly stated, "there is no silver bullet single solution.... it requires a major investment which is difficult to find when the attention is on reducing overhead costs in a downsizing environment."[1] Because an APDE-like concept is relatively new and evolving, an understanding of the context of why and how organizations create them is essential. Our research further investigated barriers encountered in adopting an APDE. Not surprisingly, the researchers noticed a wide-range of reasons, both supporting and limiting APDE development.

Obstacles

Understanding the Requirements

Even though organizations are conducting business using digital technology, very few of those interviewed possess a coherent game plan that outlines the requirements and objectives for integrating digital environments. The knowledge level of particular software packages like e-mail (considered the *life blood* by some organizations), word processors, spreadsheets, and their respective benefits to individuals are high; *understanding how to integrate digital environments across functional areas and processes are low*. Few organizations know of, or construct, a concept of operations that address what data they need, why, when, where, how, and for how long. Instead, most organizations tend to specify short-term data requirements without linking the information environments for the long run.

Quite a few organizations mimicked what one major defense contractor called "islands of

databases." The norm appears to be a multiple collection of unique databases tailored for specific departments responding to specific customers who want to share information between two points, electronically. Some databases have duplicative functions; others possess little growth potential; and some have limited interoperability. In one case, an organization was still hesitating over what type of digital environment to employ after spending over a half million dollars on a system that did not work.[2] In another instance, both a Program Management Office (PMO) and its prime contractor maintain identical technical drawing databases. The PMO's database is the official one. Ironically, the one most used is the contractor's because it is more current.[3]

There are many misconceptions regarding the need and general employment of an integrated digital environment. Only a limited number of the sites visited appreciate what integrated digital environments offer, what constitutes one, and what initiatives are available to help their organization develop one best suited to meet their needs. Interestingly enough, most organizations who did recognize the need are not cognizant of any guidance to help them construct one. Organizations feel they are on their own and tend to reinvent the wheel.

Learning Curve

Another obstacle limiting the understanding of APDE-like systems has been the slow migration of certain enabling digital technologies within the ranks, selling its usefulness, believing in its cost savings, and breaking cultural barriers. There are many personnel, especially at the senior level, who do not feel comfortable with digital technology nor appreciate the impact it might have on improving or streamlining their organization's fundamental processes. According to CAPT (USN) Joe Dyer, F/A-18 PM, people are becoming more comfortable with information technology, the cornerstone to making an APDE work, and time is helping more than anything else.[4]

Security Concerns

In some cases, there is resistance to move further into an APDE despite savings perceptions because of security concerns. Not unlike most organizations, the V-22's joint contractor teams' original concern involved the protection of proprietary data and initially insisted that information not be passed over the Internet.[5] Security is and will continue to be a concern. It is believed that the military's computers are probed by outsiders close to 500 times a day, via password sniffers, spoofers, and holes in the web.[6] However, research shows most organizations overcome these concerns by possessing either organic security experts or by hiring outside specialists who understand the regulations and standards, recognize the threat, and can implement the appropriate safeguards without creating interoperability problems.

Paper-Based and Bureaucratic Processes

Another area which organizations find difficult to overcome is the reliance on paper-based processes, especially within the Department of Defense (DoD). Several defense contractors are still delivering aperture cards—design drawings captured on microfiche, see Figure 4-1—to the field sustainment activities because the sustainment community does not possess the infrastructure to support digital processing.

In one case, a defense contractor establishing a digital design environment was asked to convert their digital drawings to aperture cards—which the sustainment community now scans back into digital drawings (with less resolu-

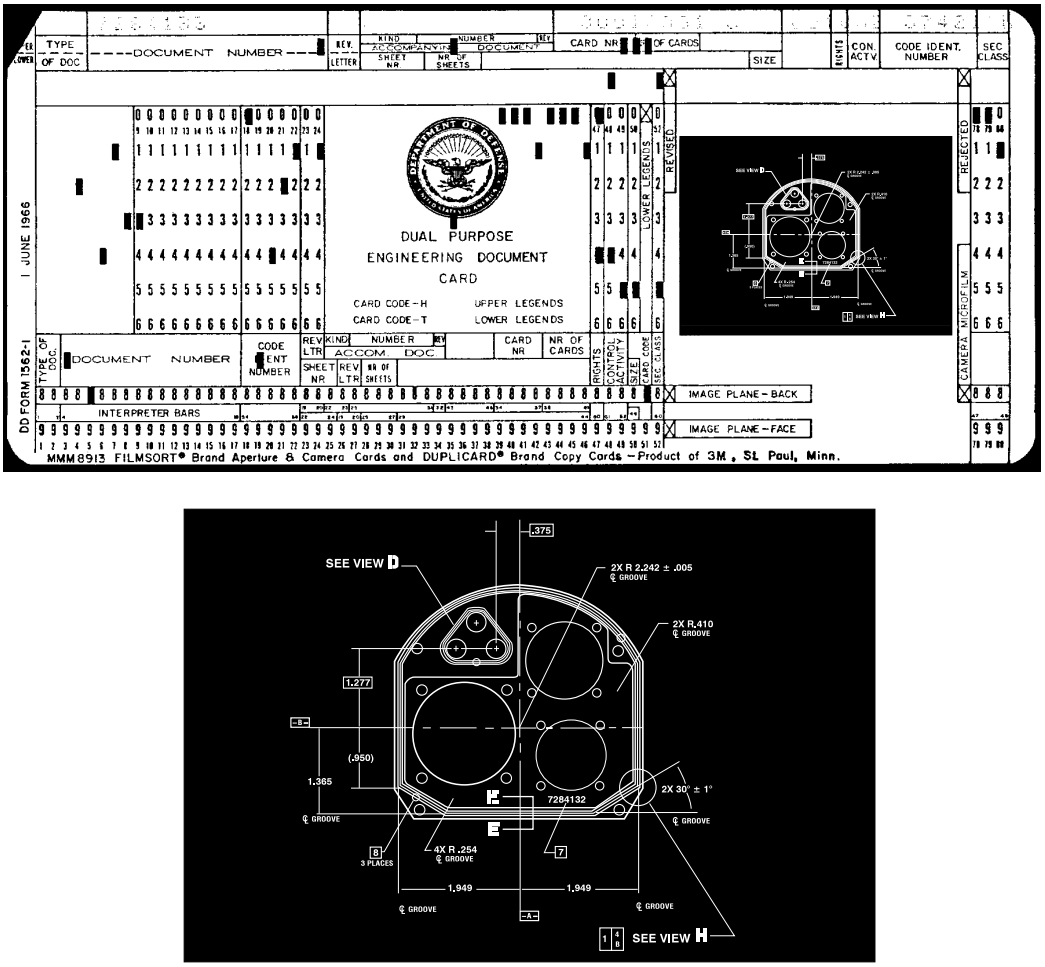

Figure 4-1. Sample Aperture Card

tion). In another case, a major PMO receives most of its data digitally, but also requests paper copies for all the drawings requiring coordination and approval.

Mr. Norman R. Augustine, President and Chief Executive Officer, Lockheed Martin Corporation, recently highlighted a classic example of the over burdening paper bureaucracy that creates a certain frustration for industries who do, or did, business with the government. When he operated the company's astronautics business (then Martin Marietta), Mr. Augustine bought gaskets for the Titan launch vehicle yearly from a supplier who primarily supported the automotive industry. Mr. Augustine imposed all of the "government's inspection and paperwork requirements as stipulated by the government's procurement regulations."[7] One day a box arrived filled with gaskets and a note attached from the supplier's president indicating the company wanted to support national

defense efforts, but they could no longer do business with Martin Marietta. "It ended by saying, 'Here is a five year free supply of gaskets. Now, would you please go away and leave us alone?"[8]

In the summer of 1995, the Deputy Under Secretary of Defense (Logistics) (DUSD (L)) launched an initiative to help educate and expose the military acquisition corps to the fundamentals of an integrated information environment. Thrust Teams were created comprising of the Services, DoD, and other agency members. The eight teams are primarily logistics focused and thus do not appear to have either the authority or necessary influence over the DoD acquisition communities.

- Business Process Improvement
- Digital Product Data
- Education and Training
- Government/Industry Interface
- Integration
- International
- Standards and Specifications
- Technical Data Management

The DoD does offer specific training through the Defense Acquisition University (DAU) for the implementation of integrated information environments in varying degrees, but no comprehensive course for PMs. Again, the training courses are functionally based.

Evolution of APDEs

Several organizations included in the research are developing APDEs, although full implementation depends on how they channel efforts in a few key areas such as:

- Standards and a common data environment;
- Digital connectivity;
- Information life cycle;
- The Internet;
- Raising interest up the chain;
- Contractor Integrated Technical Information Service (CITIS);
- Funding;
- Workflow managers; and
- Training.

Standards and a Common Data Environment

Lately, there has been a great deal of movement from more rigid military standards to commercial standards because of the potential for significant savings. The DoD is actively pursuing the use of commercial standards such as ANSI X12, standard generalized markup language (SGML), initial graphics exchange specification (IGES), and Standard for The Exchange of Product model data (STEP). The same appears to apply in the preference of commercial off-the-shelf (COTS) over government off-the-shelf (GOTS) packages. Quite a few organizations interviewed institute commercial products as a solution for the management, exchange, manipulation, and storage of electronic data, because few DoD sponsored standard systems like joint computer-aided acquisition and logistics support (JCALS), joint en-

gineer data management information control systems (JEDMICS), and configuration management information systems (CMIS) are still under development, not yet mature, and considered by some to be less capable than commercial alternatives. Some organizations also want to avoid the *Ada paradox*, according to a senior DoD official, where what had been originally designed to be a solution to interoperability has become a burden for everyone.

In the field, program partners are making agreements regarding what formats should be used for sharing databases and what works today. Even though the focus appears to be on short-term data reusability, there is a growing interest to consider the long-term data requirement. However, the imposition of standards like SGML and STEP are often misunderstood, too costly, or unnecessary—an expensive proposition to push during the design process without a demonstrated need. Another difficult choice organizations have to make is the selection of a common operating environment that is interoperable with their business partners. One organization requires people to use up to six separate systems a day to access program information because the organization can not select a common system or incorporate adequate interoperability among the different databases being used on a daily basis.[9] Fixing this problem, according to one program manager (PM), is like "mission impossible" trying to deliver against multiple requirements when trying to operate in an Integrated Process and Product Development (IPPD) environment (see Figure 4-2).[10]

More and more, senior DoD staff personnel stress getting away from military standards. Military standards are not kept current with todays' technology and prevent PMOs from working faster, better, and cheaper.[11] Not surprisingly, organizations like the U.S. Navy's

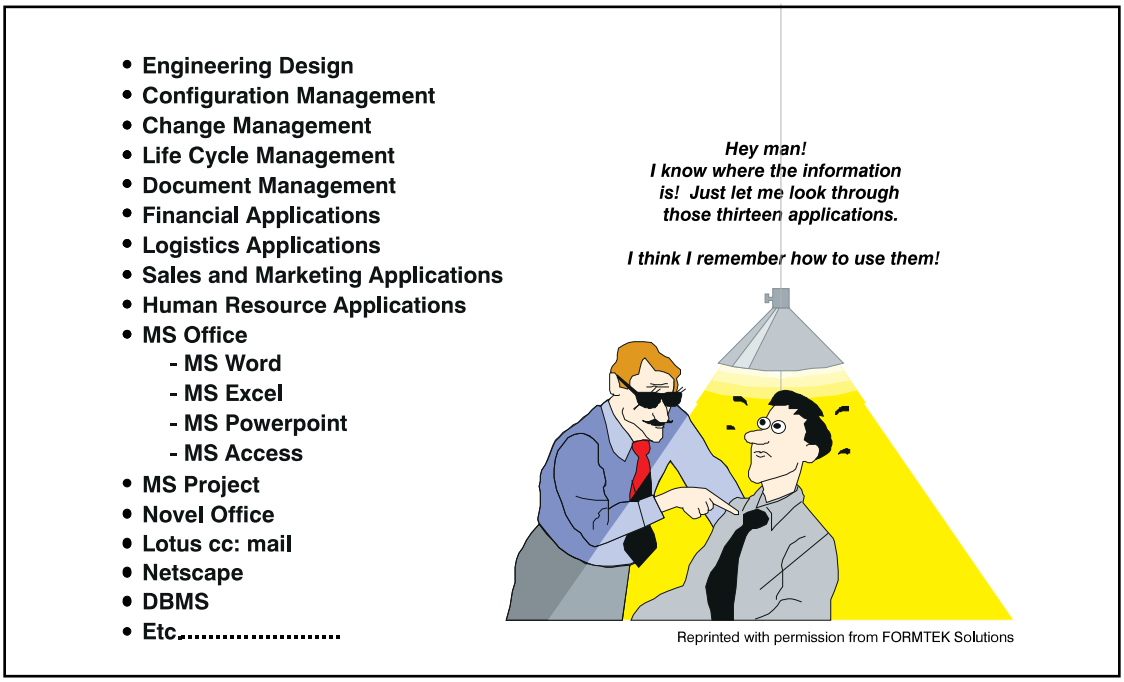

Figure 4-2. Data Access Today

PM-299 PMA, Airborne Low Frequency Sonar program, capitalizes on a common system utilizing a COTS solution. The COTS solution helps PM-299 PMA establish a common integrated information environment similar to an APDE. Avoiding proprietary specialization, they now have access to data, a full workflow manager, and work scheduler. Instead of conceiving their system as a functionally distinctive logistics product, they look at it from an overall IPPD structure to include acquisition *and* logistics. The PMO uses a mature product information management system that manages, controls, and automates the process employed to create, review, release, and manage program information during the acquisition phase. While the weapon system is in operations, the same integrated information system will be utilized.

Likewise, the Air Force's F-22 PMO recognizes that while most of their development and support data are in digital form, there is no integration across functional boundaries. As a result, the PMO is developing application interfaces within their integrated weapon system database (IWSDB) that will link disparate domains across the acquisition and operational spectrum. Figure 4-3 shows such integration across functional entities. The results will permit the developer, maintainer, and user to ask questions at any level of complexity, retrieve the appropriate data, and take corrective action, as appropriate.

Organizations with established common information environments understand the payoff. Boeing's Commercial Airplane Group talks frequently about the significant savings they achieved during the development of the 777 aircraft series. Boeing exceeded their goal of lowering engineering change requests and achieved a 93 percent reduction over the 767 program by instituting a common computer-aided design/computer-aided manufacturing (CAD/CAM) system among their supplier base. Likewise, the U.S. Army's Patriot Missile Program is getting their message out on the World-Wide Web (WWW). Through a *paperless* engineering change proposal (ECP) environment, they electronically dispositioned over 130 ECPs without holding a single "face-to-face" Configuration Control Board (CCB) meeting in over a year. The PATRIOT program reports a first-year savings of $250K, through the elimination of paper, reduction in travel, and the migration into a common system information environment.[12]

Another advocate of common digital environments is the Joint Strike Fighter (JSF) Program Office, formerly Joint Advanced Strike Technology (JAST) Program Office, located in Crystal City, Virginia. They operate in a paperless environment, unless by exception. Early on, the JSF program office pushed electronic procurement hard, even though there were few standards or experienced personnel to guide such efforts. They train, make decisions, plan upcoming phases, receive and evaluate deliverables, award contracts, conduct frequent management reviews, and review technical information—all electronically in a common data environment. In addition, they have on-line access to contractor's management information systems (MIS). The JSF program also uses an Internet Web site to: distribute solicitations, broad agency announcements, and Request for Proposals (RFPs); respond to questions from potential offerors; inform prospective bidders of the latest information that might affect contract proposals; and answer questions related to their solicitations. The JSF program has declared business with them will take place digitally and subscribes to a common information systems environment.

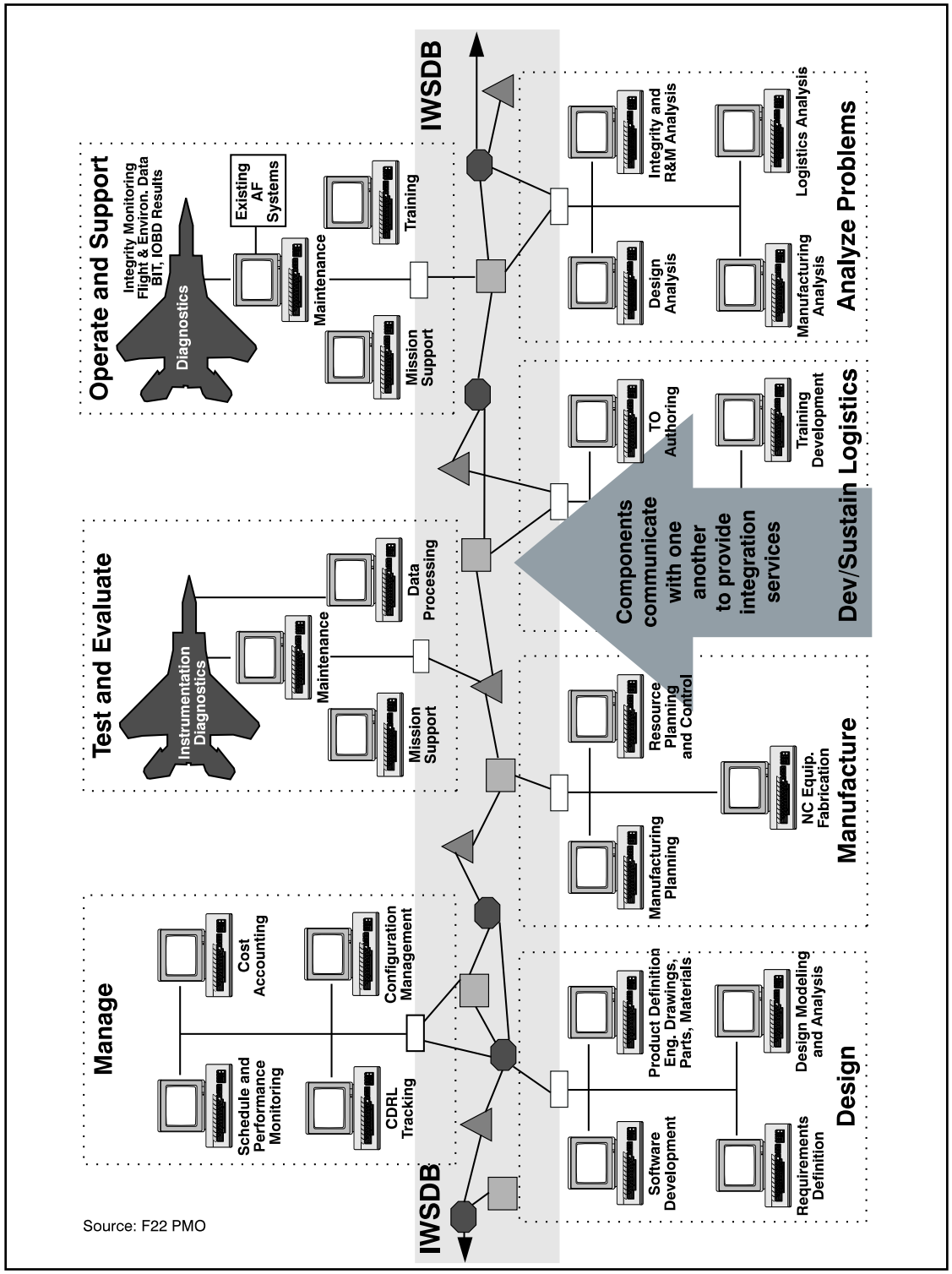

Figure 4-3. F-22 Integrated Weapon System Database

Information Life Cycle

A cultural boundary blocking the systematic development of an APDE is the result of the DoD acquisition process encouraging PMs to be milestone driven. Even though they make decisions that will impact the total life cycle costs for their weapon system, PMs rarely stay with the same program once its fielded. There is concern this approach reduces the motivation to view information as a long-term asset, and accommodate design decisions which *may* have projected life cycle savings but incur short-term costs. There is also a belief that such "up front" investments may defer other critical initiatives even though the downstream savings of an APDE covers the initial infrastructure costs. Unfortunately, PMs are evaluated on reaching the next milestone on time within current annual budgets, and have little incentive to reduce long-term life cycle costs. To correct this problem, a few organizations like the LPD-17 project (the U.S. Navy's newest class of amphibious vessels which will functionally replace a number of ships) are establishing an integrated APDE concept early and expect to reap significant long-term savings by "designing for ownership." They view information as an asset and accept that this may incur an initial up-front investment, but expect to reduce traditional life cycle maintenance costs by 40 percent.[13] Figure 4-4 depicts the LPD-17 life cycle vision. Because the LPD-17 project emphasizes rapid, affordable performance upgrades as a fundamental design principal, they recognize what data should be bought digitally, and how it should be integrated and reused.[14]

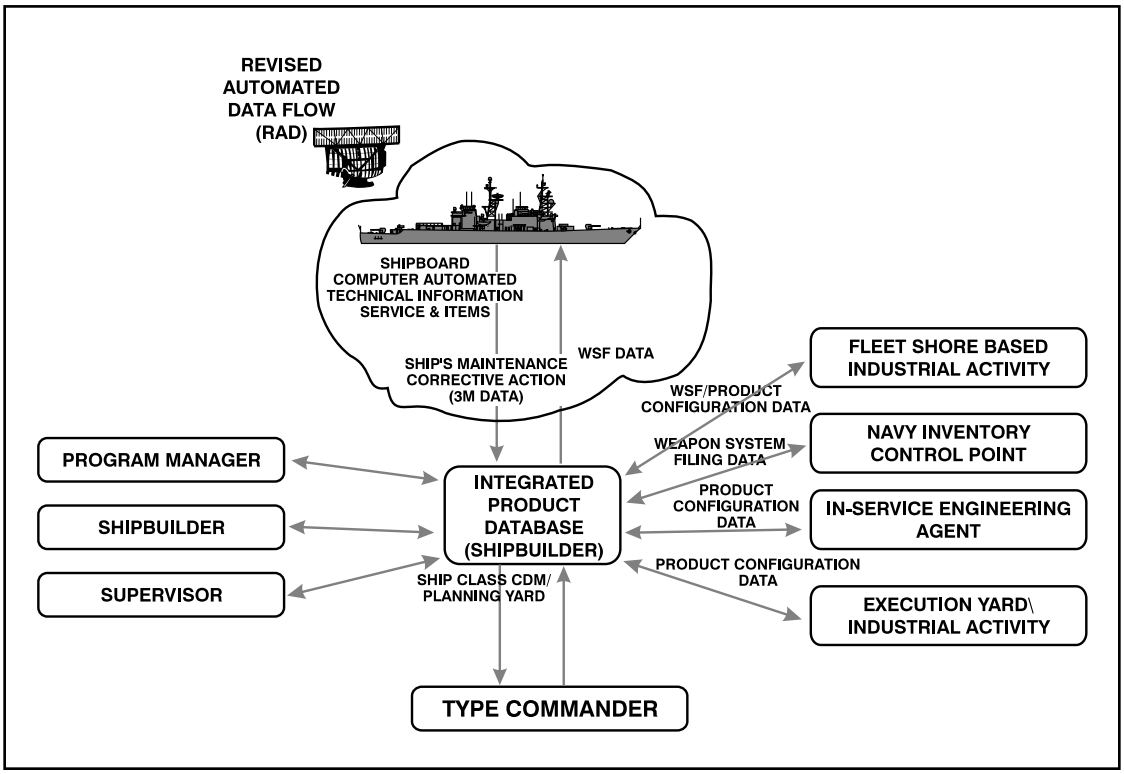

Figure 4-4. LPD-17 Life Cycle Vision

At the same time, however, there are many legacy programs like the U.S. Air Force's C-17, that started the design process on paper well before integrated digital environments were realizable. Recently, they have started evaluating digital opportunities, although much later in their design process. Of the almost 26,000 drawings covering about 126,000 parts in the C-17, less than 15 percent was actually produced in digital form, making movement up the APDE continuum more difficult.[15] As part of an Omnibus Program to digitize and integrate more of their processes, the C-17 PMO is carefully evaluating options to meet future data needs. One option is access to a sustained CITIS environment after the C-17 is fielded.

Raising Interest up the Chain

The impetus for generating most integrated APDEs is often originated by advocates lower in the ranks, and survive only with senior leadership support. At one defense contractor facility, an individual responsible for helping craft an integrated information environment faces a lack of understanding from corporate leaders, coupled with a lack of incentive from the DoD. Another defense contractor has three separate groups developing similar systems for their respective digital environments at the program level, because senior management provided neither oversight nor developed a corporate approach. In many cases, the appropriate people at the helm who are in positions to help are uninformed, feel uneasy about the technology, and are unsure about its application. One senior individual in a DoD PMO is doubtful what an integrated information environment provides. If there is not at least real-time access to the financial reporting system of the prime contractor, there is no point in having the system. Not surprisingly, that same organization's digital infrastructure is weak and divided. There is no master plan and its organizational members can not readily access the required data when they need it. Notwithstanding, as a general rule, increased interest and attention by senior leadership normally pays off even though most of the time it is a *tough sell*. Many organizations, particularly ones competing in commercial markets, are actively integrating the digital activities within their enterprise. They can not afford the consequences of sitting idle and believe their competitors will acquire an advantage, and ultimately gain market share.

One organization's development of operations and formulation of an overall business strategy involves percolating questions to senior executives to properly tackle data requirements and construct a suitable APDE.

- Should we standardize?
- Should we have a single face to our suppliers and customers?
- Would standard interface definitions and implementation conventions for exchanging data with customers reduce support costs?
- Are there requirements for an application architecture to bridge source systems and trading partners?
- Should we deploy a CITIS to our customers and suppliers?
- What are the common requirements across business to manage, access, and distribute technical data?

Many organizations have different motivations to adopt digital environments. One organization believes downsizing is the incentive to go digital. Other organizations focus on process

oriented motivations and look at the cost of ownership early; becoming convinced that understanding long-term data needs and information interoperability would reap major savings in life cycle costs. A few organizations who successfully advance along the APDE continuum simply do so because personnel resources are diminishing, evidence shows it is a profitable proposition, it opens avenues to new markets, or provides customer service enhancements.

Funding an APDE

In the absence of direction, organizations weigh the requirement for integrating their digital environments principally for two major reasons—competitiveness and profitability. Organizations tend to support the development or mandating of common databases, standard transaction sets, and/or integrated workflow activities between themselves, their trading partners, and/or supply chain—if the return on investment (ROI) is apparent. A cost-benefit analysis has to be shown. If the need is not apparent to senior leadership little attention is given to funding an APDE. However, senior leadership is easily persuaded to adopt an APDE approach when cost savings are shown to be dramatic. One organization estimates that processing a paper purchase order cost $70, as compared to 93 cents processing the same purchase order electronically.[16] For some organizations, the results of the cost-benefits analysis highlight the advantages of purchasing computer equipment for their suppliers, thus creating a shared data environment. In another case, an organization provides a preferred pricing arrangement on a particular CAD/CAM software application to their supplier, establishing a shared common system design environment, helping them overcome costly standardization issues.

Despite the perceived savings, sometimes moving to an integrated information environment is inhibited by the organizations' size and entrenched infrastructure. According to one organizations' in-house observer, they are slow to incorporate an integrated information environment because it takes "a while to get our rudder in the water and get the ship turned around."[17] This was also true within DoD. Acquiring funds, and sometimes protecting the funds, for an APDE is difficult given a limited budget for infrastructure and misunderstanding of the long-term payoffs. The U.S. Army's Combat Mobility Systems (CMS) program sought assistance and secured additional funding to help finance an APDE. After screening the PMs' information requirements and deploying an APDE, the PMO quickly discovered a number of significant tangible benefits:

- Improved business processes for increased efficiency;
- Assisted in efficient resource allocation;
- Reduced redundancy in work load;
- Reduced administrative burden;
- Reduced manpower associated with status reporting;
- Placed information in a common environment to allow data sharing;
- Enabled personnel to quickly locate information on demand;
- Expedited exchange of information, facilitating better communication;
- Provided infrastructure for immediate access and delivery of program information;

- Provided means for data review and comment on-line; and

- Provided capability to investigate and obtain timely information on demand.[18]

Another PMO needed to demonstrate to the Systems Commander an ROI before making any further purchases in digital technology. Later, they were given the green light to deploy a system for $2M and quickly realized $2.7M in savings in the first few months.[19]

Training

With little exception, the research found most organizations do not possess the corporate knowledge or a training program to support creating, feeding, and nurturing an integrated APDE. Successful organizations interviewed seek outside consultation or develop a core group of organic expertise, but the majority are not actively exposing their personnel to the benefits of an APDE-like system. One organization admits to making it up as they go along, because those responsible for implementing a new system are in the process of learning themselves.[20] As one project manager states, "the training PMs and other personnel receive on digital technology and/or processes is either on the job or whatever they can obtain on their own."[21] Most site visit interviewees appreciate what APDEs offer and feel training needs to be a top priority; at the corporate level there is no evidence this is taking place or emphasized. In some cases, even when formal training is offered, it is generally given low priority and not well attended when scheduled.

In both DoD and industry, the predominant digital-related training courses apply to electronic data interchange (EDI), ANSI X12, continuous acquisition and life cycle support (CALS), basic software applications (E-mail, word processing, database applications, spreadsheet, etc.). EDI training predominantly limits itself to contracting and purchasing; while CALS training courses concentrate on logistics and sustainment of mature product data for the logistics community. In one organization, general tutorials, self-help opportunities, and library materials on digital initiatives are available yet seldomly used. Overall, training appears to be functionally based. There is no focus on integrating functions and processes.

Digital Connectivity

Most organizations surveyed have an e-mail system internal to their organization. Primarily, the e-mail provides a means of basic communication and file sharing. In some organizations e-mail can be used as a fundamental enabler for greater digital connectivity, streamlined communication, and decreased response time; all which ultimately result in increased productivity. Most e-mail systems also have Internet access. However, in many cases individuals do not use external e-mail, which is directly attributed to lack of training or an uneasiness about using digital environments as opposed to using paper environments. Organizations that routinely transmit e-mails outside the organization tend to better appreciate the possibilities for cross functional, integrated digital environments.

The development of an APDE requires an understanding of digital technology and the cross functional nature of information. Many organizations rely on their MIS personnel to set an APDE into motion and expect them to select the necessary infrastructure. Unfortunately, the MIS personnel are usually consumed by daily hardware and software operations. They tend to system crashes, update software and hardware, plan for future upgrades, schedule computer training, or explain why the computer

network is down. In many cases, MIS personnel do not have an understanding of data requirements, and consequently are unable to develop an APDE to support those requirements.

Internet

Probably one the most interesting areas where organizations are beginning to explore other prospects of digital interconnectivity is the Internet. The earlier Local Areas Networks (LANS) that evolved into wide area networks (WANS) have now become the widest global area network—the Internet.[22] Many organizations have browsers, such as Netscape, on desk top computers giving personnel access to the World Wide Web (WWW) to probe relevant sites and potentially expand business opportunities. Some commercial organizations offer virtual storefronts on the WWW to reach new markets; while others use it to speed communications. The Bank of America uses the Internet for making payments with an astonishing round-trip transit time under ten minutes, including processing times at both ends.[23] One organization establishes a set of metrics giving them an indication how marketing on the WWW brings in additional business. Organizations who extended their reach even further along the APDE continuum appear to be supporting the exploration of even other Internet prospects. An advocate in one commercial organization believes the Internet possesses the inherent functionality to integrate more of the organization's internal and external digital processes. Senior leadership supported a "proof of concept" demonstration for the on-line exchange of digital data between their organization and its supplier base solely via the Internet. The demonstration, conducted from an employees home gained access to the organization's corporate network, and transferred data across the Internet to the supplier base. While this demonstration did not employ exotic encryption methods, partition data to authorized users, or incorporate workflow functionality, it did illustrate the benefits of simplified real-time access to data between the organization and its suppliers. It also shows the reliability and simplicity of the Internet. The demonstration involved password protection techniques, Web browsers, form submission tools, and e-mail via hyperText markup language (HTML). In terms of savings, transferring manufacturing data via the Internet during the demonstration had an expected reduction in physical media costs of 78 percent and a reduction in turn-around time of 92 percent.[24]

The Non-Line of Sight (NLOS) PMO, which is developing the Enhanced Fiber Optic Guided Missile (EFOGM) for the U.S. Army, constructed a similar Internet model, placed it into practice, and are quite pleased with the results. All documentation for the weapon system development generated by the contractor team such as trade studies, requirements and design specifications, briefings, cost documentation, analysis results, plans, reports, etc. are created in an integrated electronic environment and delivered to the NLOS PMO via the Internet. Minimal hardware and software expenditures account for increased program savings.[25]

The Internet does present a few security concerns driving many organizations to use point-to-point digital connections as either a primary or back-up device. However, many organizations believe the Internet's attributes will make it the vehicle of choice for a number of reasons:

- Ease of use;
- Multimedia capability;
- Relatively low cost of access; and

- Wide range of Web compatible COTS options.[26]

Another major defense contractor believes the Internet is extremely attractive to disadvantaged business suppliers who cannot normally afford multiple non-standardized digital solutions.

CITIS

The careful design of a CITIS is probably the most important decision a PM can make in satisfying program data needs through an APDE. This is especially true in light of the new requirements of DoD 5000.2-R which states: "Support concepts of new and modified systems shall maximize the use of contractor provided, long-term, total life cycle logistics support."[27] In most cases, a contractor's CITIS is robust enough to provide easy access to the data. This research revealed many variations in how DoD organizations establish and maintain connectivity amongst information environments. MIL-STD-974 defines the functional requirements for CITIS, and has permitted a great deal of flexibility as evidenced by its four implementation strategies.

- Database repository resides with the prime contractor as a single physical integrated database.

- Database repository resides with the prime contractor as distributed multiple databases with a navigator (gateway processor).

- Database repository resides with the prime contractor; existing information systems are interfaced to extract CITIS data in a central repository.

- Database repository resides with the prime contractor and suppliers (many), with a navigator to pass requests/access to supplier databases.[28]

Some PMOs tap directly into a prime contractor's CITIS, located either inside or outside the contractor's firewall and extract the appropriate data on demand. (See Figure 4-5.) Other PMOs avoid a CITIS and have the contractor deliver digital data to a remote server which is operated and maintained by the sponsor.

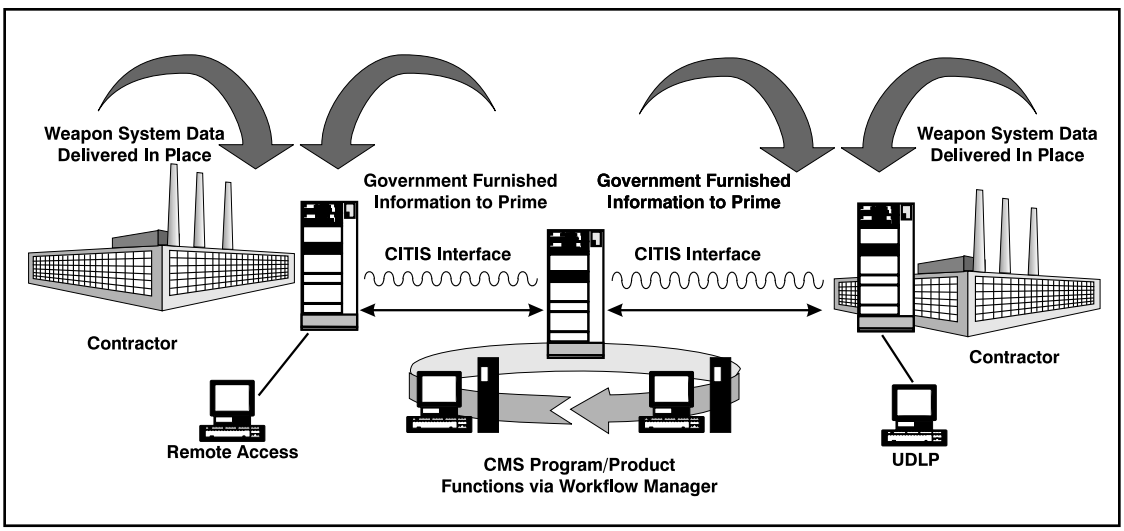

Figure 4-5. CMS CITIS Arrangement

Producing an efficient CITIS and justifying its usefulness is not an easy undertaking. A CITIS should have certain characteristics that everyone on the team understands and be simple to use. CITISs must be reliable and straightforward; otherwise, the exchange of digital information whether technical data, drawings, schedules, or general reports can become a cumbersome and inefficient operation.

In one case, the implementation of a CITIS turned into a disaster. A PMO contracted for a CITIS and expected a far more integrated and automated environment—a point-and-click approach. The delivery was an "awkward X-windows character-based monstrosity" which the PMO essentially refused to use.[29] To overcome this situation the PMO's expert MIS, joined by a support contractor, built a Web server to access CITISs manually. Each document was placed on the Web server for access by the integrated product teams (IPTs), with a point-and-click capability. Although tedious to develop, operations ran smoothly forcing the contractor to abandon the original CITIS approach and begin utilizing the government's Web server for obtaining copies of their own documents.[30] Eventually the contractor replicated the PMO's design on their own system, thus recognizing the advantage for them to be the sole curator of the document repository.

Another organization discovered that to even sell a CITIS environment to the PMO and senior management, they had to demonstrate the service. An actual CITIS simulation generates a high degree of interest, excitement, and buy-in at all levels, as opposed to the previous marketing method of slide shows and paper documents.

Some organizations, however, do not feel comfortable with CITISs. They are concerned about the proprietary nature and data security. In one case, it is believed the risk of direct access leads the contractor to charge more than the government is willing to pay for a CITIS. Interestingly enough, the same commercial organization's sister site has already given the government unlimited access to another CITIS environment.

In two cases, the PMO has decided to forego a true CITIS implementation. The PMOs decided to maintain their own servers and have their contractors populate these servers with contract data requirements list (CDRL) data that are ordinarily available via CITIS. In one case, there is concern over contractor access to government data. In the other, the contractor's CITIS implementation is not compatible with government software applications.

How a PMO views the life expectancy of a CITIS after selecting one of the four CITIS implementation strategies is often a result of how satisfied the organization is with the CITIS environment in general. In some cases, the government decides to have the contractor develop and maintain a CITIS, exclusively, throughout the life of the weapon system; as in the case of the Air Force's B-2 program. After conducting a feasibility study, the B-2 PMO decided to have its principal contractor, Northrop Grumman, house and maintain a certain set of digital data required for field operations and maintenance which the government originally purchased. It is envisioned that the field unit will tap into Northrop Grumman's CITIS on demand and retrieve the appropriate technical manuals, engineering drawings, etc. Information location is transparent to the user. The key is information is available where they need it, when they need it, and in a cost effective and timely manner, satisfying the spirit of DoD regulation 5000.2-R.

The Air Force's B-2 program is a good example of a legacy program that migrated to a CITIS

environment and was able to move further down the APDE continuum much later in their program's acquisition life cycle. They originally admitted having islands of databases which were costly to maintain and disjointed. They launched an effort to integrate their information environments late by showing the savings in total life cycle costs. After the CITIS Phase II is complete they will have digitally linked 66 data elements comprised of engineering drawings (3-D and 2-D), desktop publishing documents, and routine documents in an integrated digital fashion. While the implementation cost of $27.2 million is high, the expected savings over the long-term is significantly higher.[31]

Workflow Managers

Workflow managers, described in Chapter 2, are key enablers for integrating and automating processes, and supporting IPTs and IPPDs. A few organizations are incorporating a wide variety of tools like workflow managers into their integrated digital environments. Figure 4-6 depicts one organization's vision of how a workflow manager fits into APDE-like infrastructures.

In many cases, however, organizations establish cross-functional work group membership on e-mail systems and use it in a quasi-workflow manager fashion. Unfortunately, problems occur. Team membership keeps changing, forcing continual modification of personal e-mail group directories to reflect current membership. In a few other cases, the team members hunt for the information they are expecting to review, thinking they have access authority, or have access authority, but can not easily access the information they need. Products like e-mail, project management, and

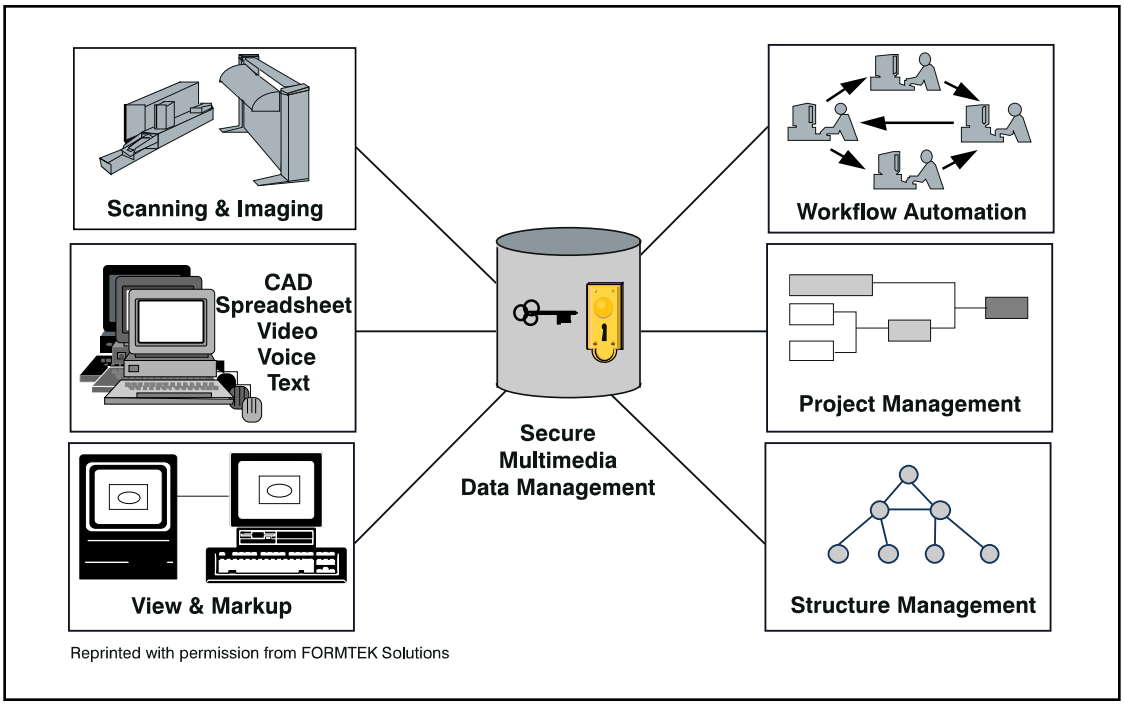

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Figure 4-6. FORMTEK Solutions

scheduling are low cost productivity tools but "do not allow for coordinating or tracking processes with multiple steps and/or multiple users."[32]

Most of these problems can be overcome by genuine workflow managers. Because of its recent emergence, the concept of workflow managers are relatively unknown by most organizations. However, those organizations who employ workflow managers are excited about its applicability, pleased with its ease of use, and have already seen a marked improvement in data flow between the cross-functional teams. Some commercial organizations see workflow managers as a distinct competitive advantage. One commercial organization shortened the business processing time from 14 days to 4 days and feels delivering faster than the competition is one of the few edges left in a very competitive marketplace.[33] A defense contractor noticed how quickly they could check for work completion, uncover design problems, incorporate the necessary modifications, and notify the appropriate personnel of changes, thereby greatly reducing the entire approval cycle and improving the organi-zation's overall performance.

Summary

While there are many innovative digital initiatives ongoing throughout DoD, for the most part, the acquisition community is not fully prepared to capitalize on the benefits or potential of integrated digital environments. Implementation of digital environments widely differs between the Services and PMOs. Lessons learned by industry in the exploitation of the information age and information technology are not well understood or appreciated within PMOs. The driving forces for organizations to adopt APDEs are reducing overall costs and increasing performance; not policy, mandates, or DoD direction. The evolution of an APDE typically starts with common data environments and standardized business practices at a local or process level, and with short-term objectives. Few PMOs appreciate the ramifications of an inoperable data environment at the program level—islands of databases which are functionally based, duplicative, disjointed, and force lengthy serial processes. Fewer still develop an overall long-term digital master plan supporting data reuse and treating information as a life cycle asset. Some organizations discover an important element toward integrating digital environments is a CITIS, a first step toward overcoming disparate government and contractor databases. Some are more innovative and explore emerging technology such as CAD/CAM, Internet, and workflow managers. Those who recognize how an APDE will improve efficiency and integrate processes are often junior in rank, seeing themselves as change agents despite a tough sell with senior management. Regardless, many organizations involved in adopting commercial products, standards or conventions for the creation, manipulation, and exchange of data are realizing immediate gains. Even where short-term gains are not evident, the overall long- term benefits in terms of productivity and supportability are recognized and deemed worth the up-front costs.

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